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Customer Number 22,852
Attorney Docket No. 02814.0050

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors: Christopher Gordon Gervase TURNER et al.

Serial No.: 09/878,403

Filed: June 12, 2001

For: READING PROTOCOL FOR TRANSPONDERS OF ELECTRONIC IDENTIFICATION SYSTEM

Group Art Unit: 2635

Examiner: Not Assigned

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

CLAIM FOR PRIORITY

Under the provisions of Section 119 of 35 U.S.C., applicants hereby claim the benefit of the filing date of South African Patent Application No. 2000/2937, filed June 12, 2000, for the above identified United States Patent Application.

In support of applicants' claim for priority, filed herewith is one certified copy of the above.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, L.L.P.

Dated: October 3, 2001

By: _____
Ernest F. Chapman
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Sertifikaat

REPUBLIEK VAN SUID-AFRIKA

Certificate

PATENTKANTOOR

PATENT OFFICE

DEPARTEMENT VAN HANDEL EN NYWERHEID

REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF TRADE AND INDUSTRY

Hiermee word gesertifiseer dat
This is to certify that

1) South African Patent Application No. **2000/2937** accompanied by a Provisional Specification was filed at the South African Patent Office on the **12 June 2000**, in the name of **Supersensor (Proprietary) Limted** in respect of an invention entitled: **"Reading protocol for transponders of electronic identification system"**.

2) The photocopy attached hereto is a true copy of the provisional specification and drawings filed with South African Patent Application No. **2000/2937.**

RIA in die Republiek van Suid-Afrika, hierdie 21 dag van June 2001
in the Republic of South Africa, this day of

Registrateur van Patente
Registrar of Patents

Form P.2

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978

REGISTER OF PATENTS

P/00/78407

OFFICIAL APPLICATION NO.	LODGING DATE : PROVISIONAL	ACCEPTANCE DATE
21 01 20002937	22 12-06-2000	43
INTERNATIONAL CLASSIFICATION	**LODGING DATE : COMPLETE**	**GRANTED DATE**
51	23	47

FULL NAME(S) OF APPLICANT(S)/PATENTEE(S)

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APPLICANTS SUBSTITUTED:	DATE REGISTERED
71	

ASSIGNEE(S)	DATE REGISTERED
71	

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2. McMURRAY, John

PRIORITY CLAIMED	COUNTRY	NUMBER	DATE
N.B. Use International abbreviation for country. (See Schedule 4)	33	31	32

TITLE OF INVENTION

54 READING PROTOCOL FOR TRANSPONDERS OF ELECTRONIC IDENTIFICATION SYSTEM

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P/00/78407

PATENT OF ADDITION NO.	DATE OF ANY CHANGE	
61		
FRESH APPLICATION BASED ON	**DATE OF ANY CHANGE**	

D.M. KISCH INC. , Johannesburg

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REPUBLIC VAN SUID-AFRIKA 2000 REPUBLIC OF SOUTH AFRICA 445

Form P.1

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT
(Section 30 (1) - Regulation 22)
The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate.

PATENT APPLICATION NO.		AGENT'S REFERENCE
21 01	20002937	P/00/78407

FULL NAME(S) OF APPLICANT(S)	
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REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT
2000 -06- 12
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

TITLE OF INVENTION	
54	READING PROTOCOL FOR TRANSPONDERS OF ELECTRONIC IDENTIFICATION SYSTEM
	THE APPLICANT CLAIMS PRIORITY AS SET OUT ON THE ACCOMPANYING FORM P.2. The earliest priority claimed is
	THIS APPLICATION IS FOR A PATENT OF ADDITION TO PATENT APPLICATION NO. 21 01
	THIS APPLICATION IS A FRESH APPLICATION IN TERMS OF SECTION 37 AND BASED ON APPLICATION NO. 21 01

THIS APPLICATION IS ACCOMPANIED BY :

X	1	A single copy of a provisional ~~xxxxxxxxxxxxxxxxxxxxxxxxx~~ complete specification of 12 pages.
X	2	Drawings of 3 sheets.
	3	Publication particulars and abstract (Form P.8. in duplicate).
	4	A copy of Figure of the drawings for the abstract.
	5	An assignment of invention.
	6	Certified priority document(s) (State number).
	7	Translation of priority document(s).
	8	An assignment of priority rights.
	9	A copy of Form P.2 and specification of S.A. Patent Application No. 21 01
	10	A declaration and power of attorney on Form P.3.
	11	Request for ante-dating on Form P.4.
	12	Request for classification on Form P.9.
	13	

DATED THIS 12 th DAY OF June 2000

Patent Attorney for the Applicant(s)

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RECEIVED
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2000 -06- 12
REGISTRATEUR VAN PATENTE, MODELLE,
REGISTRAR OF PATENTS

D.M. KISCH INC. , Johannesburg
Patent Attorneys & Trademark Agents
Attorneys & Notaries

Form P.6

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978.

PROVISIONAL SPECIFICATION

(Section 30 (1) - Regulation 27)

PATENT APPLICATION NO.	LODGING DATE.	AGENT'S REFERENCE
21 01 20002937	22 12-06-2000	P/00/78407

FULL NAME(S) OF APPLICANT(S)	
71	SUPERSENSOR (PROPRIETARY) LIMITED

FULL NAME(S) OF INVENTOR(S)	
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TITLE OF INVENTION	
54	READING PROTOCOL FOR TRANSPONDERS OF ELECTRONIC IDENTIFICATION SYSTEM

INTRODUCTION AND BACKGROUND

THIS invention relates to electronic radio frequency (RF) identification systems of the kind comprising a reader and a plurality of transponders. It more particularly relates to a protocol for reading the transponders in sequential manner.

It is well known that the total time required to read all the transponders in a transponder population is proportional to at least the number of transponders in the population and the length of the data stream (frame length) transmitted by each transponder in response to being prompted by the reader. Various schemes and/or protocols have been developed to decrease the read time. These include schemes to avoid collisions between data streams and protocols to switch off transponders already read.

A first known protocol utilizes randomly generated hold-off inter-frame intervals for the various transponders in the population to reduce the probability of frame collisions. Furthermore, once a transponder has been read, it is acknowledged by the reader and switched to a sleep mode wherein it no longer transmits and hence no longer responds to the reader. In this way the number of still active transponders in the population is decreased, thereby further reducing the probability of collisions.

A second known protocol is based on the first and in addition utilizes a mute signal aimed at muting all other transponders which start to respond after a first transponder onto which the reader has locked. However, it is not possible to mute those transponders which start responding after the first transponder, but before the mute signal is received by them. All these non-muted transponders then continue to transmit their full frame lengths of typically 90 – 130 bits. This clearly results in collisions between the frames, a failure by the reader to read the transponder and consequently there is no acknowledgment signal from the reader. The transponders only start retransmitting typically 1.5 frame lengths after the mute signal. Thus, after a collision, the system recovery time is unnecessarily slow. The bigger the transponder population, the more likely this is to happen, which slows down the total time to read the entire population.

OBJECT OF THE INVENTION

Accordingly it is an object of the present invention to provide a system, reader, transponder and method of reading the transponders with which the applicant believes the aforementioned disadvantages may at least be alleviated.

SUMMARY OF THE INVENTION

According to the invention there is provided a method of reading a plurality of transponders forming part of an electronic identification system also comprising a reader, the method comprising the steps of:

- causing the transponders first to transmit a respective part only of respective response data frames;
- causing the reader to lock onto one of said parts being transmitted by one transponder;
- causing said one transponder to transmit a remainder of the frame;
- causing the other transponders to be deactivated temporarily;
- receiving and reading the remainder of the frame at the reader; and
- upon receipt and reading of the remainder of the frame, causing the one transponder to switch to a sleep mode wherein said one transponder no longer transmits any part of the frame, and reactivating the other transponders.

The transponders may be passive transponders programmed to respond automatically with said respective parts to an energizing signal transmitted by the reader. The transponders may start transmitting the respective parts of the frames after respective randomly generated hold-off time.

The part of the frame may be a preamble only and the remainder may be a body of the frame. The preamble may be 10 to 20 bits in length and an overall length of the frame may be between 90 and 130 bits in length. In a preferred embodiment the preamble is 11 bits in length and the overall length of the frame is 128 bits. The preamble would not normally carry any information.

Said one transponder may be caused to transmit the body of the frame by a "go-ahead" signal modulated on the energizing signal. The "go-ahead" signal may also serve to deactivate temporarily the other transponders.

In the preferred embodiment, the "go-ahead" signal must be received by said one transponder within a first time window after transmission of the respective preamble, to cause said one transponder to transmit the body of the frame.

Said one transponder may be switched to said sleep mode by an acknowledgement signal modulated on the energizing signal and to be received by said one transponder within a second time window after the body of the frame has been transmitted. Said acknowledgement signal preferably also serves to reactivate the other transponders.

The reader may be programmed such that in the event of the reader receiving a spoiled preamble, to transmit a signal similar to the acknowledgement signal, thereby to reactivate the transponders. The signal may be transmitted within 10 to 25 bits after the first bit of a preamble has been received by the reader.

Similarly, the reader may be programmed in the event of the body not being received and read successfully, to transmit a signal similar to the acknowledgement signal but after the second time window, thereby to reactivate transponders not yet read successfully.

This invention also includes within its scope a system, reader and transponder as herein defined and described.

BRIEF DESCRIPTION OF THE ACCOMPANYING DIAGRAMS

This invention will now further be described, by way of example only, with reference to the accompanying diagrams wherein:

figure 1 is a block diagram of an electronic identification system according to the invention;

figure 2 is a time domain representation (not to scale) of a signal transmitted by a reader of the system and a response signal from one of the transponders; and

figure 3 is a time domain representation (not to scale) illustrating the method according to the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

An electronic radio frequency (RF) identification system according to the invention is generally designated by the reference numeral 10 in figure 1.

The system comprises a reader 12 and a transponder population 14 comprising transponders 14.1 to 14.n. In use the transponders may be mounted on or otherwise associated with items or articles (not shown) to be counted or identified. The transponders may be active transponders comprising their own local power supplies or they may be passive transponders in that they derive power to operate from an energizing signal 16 transmitted by the reader. The transponders are similar in configuration and therefore transponder 14.1 only will be described further. Transponder 14.1 comprises an antenna 18, an integrated circuit 19 connected to the antenna and comprising a modulator 20, a controller 22 and a memory arrangement 24.

In use, the reader transmits an energizing signal 16 towards the transponder population 14. The transponders derive their power from this signal (as hereinbefore described), transmit respective response signals 26.1 to 26.n by backscatter modulating the signal in known manner with a

frame of data prestored in memory arrangement 24. The reader sequentially locks onto one of the response signals and reads the data as will hereinafter be described. Once the population has been read, the aforementioned items are identified and/or counted.

The signal 16 and one example of response signal 26.1 are shown in figure 2. The response signal 26.1 comprises a data frame comprising a preamble 30 of about eleven bits long and a body portion 32 of about one hundred and seventeen bits long. Hence, the overall length of the frame is in the order of 128 bits.

In the method according to the invention, the transponders do not reply with the full frame as in prior art systems, but with the preamble 30 only, after a random hold-off period 34. The transponder then awaits a "go-ahead" signal 36 from the reader. If it is not received within a designated first time window 38, the transponder repeats the preamble after a random inter-transmission interval. If the "go-ahead" signal 36 is received during window 38, the transponder receiving the signal, transmits the body 32 of the frame. Successful reading of the frame is acknowledged by the reader 12 with an acknowledgement signal 40 within a second time window 42, which causes the transponder to switch to a sleep mode wherein it no longer responds to the energizing signal 16. The aforementioned "go-ahead" signal 36 also serves as a mute signal for all the other transponders

in the population which are still timing out their respective "hold-off" periods and which are hence not yet responding. These transponders are muted for a predetermined default period of typically 1.5 frame lengths. However, the aforementioned acknowledgement signal 40 serves to cancel the muting of the muted transponders. The purpose of the preamble 30 is merely to enable the reader 12 to lock onto and synchronize with the relevant transponder. In the preferred embodiment, the preamble does not include any information.

The operation of the system 10 is further illustrated in figure 3. The energizing signal is shown at 16 and the response signals from transponders 14.1 to 14.4 are illustrated at 26.1 to 26.4. The first transponder to respond after a random hold-off period 34.2 is transponder 14.2 with response signal 26.2. As stated hereinbefore, only preamble 30.2 is transmitted. The reader, having received and locked onto the preamble 30.2, transmits "go-ahead" signal 36.2 within the first time window 38.2 associated with signal 26.2. This causes transponder 14.2 to proceed immediately with the body 32.2 of the frame. The signal 36.2 also serves to mute all of transponders 14.1, 14.3 and 14.4. Once the data in the body 32.2 of the frame has been read by the reader 12, the reader transmits acknowledgement signal 40.2 within the second time window, to switch transponder 14.2 to the sleep mode wherein it no longer

responds to the signal 16. The same signal also cancels the muting of transponders 14.1, 14.3 and 14.4.

After a random hold-off period 34.1 (which is longer than the length of a preamble), transponder 14.1 starts transmitting a response signal 26.1, initially comprising the preamble 30.1 only. Once the reader 16 has locked onto and synchronized with the preamble 30.1, the reader transmits a "go-ahead" signal 36.1 which falls within the first window 38.1 associated with transponder 14.1. This signal causes transponder 14.1 to proceed immediately with the body 32.1 of the frame. The same signal 36.1 causes transponders 14.3 and 14.4 to mute. In a similar manner as hereinbefore described, acknowledgment signal 40.1 received within a second time window causes successfully read transponder 14.1 to switch to the sleep mode and cancels the muting of remaining transponders 14.3 and 14.4 in the transponder population.

In the example shown, transponders 14.3 and 14.4 thereafter substantially simultaneously start to transmit their preambles 30.3 and 30.4 respectively. As a result, there is a collision and not one of the preambles 30.3 and 30.4 is read successfully. The reader therefore does not transmit the "go ahead" signal and the transponders 14.3 and 14.4 cease transmitting at the end of their respective preambles. The reader 12 then within a predetermined period (such as sixteen bit periods after having received the

start of the first of the preambles 30.3 and 30.4) transmits a signal 44 similar to an acknowledgement signal 40 to cause all the remaining transponders to retransmit their respective preambles after respective "hold-off" periods after receipt of the signal 44.

Also in the case wherein the body of a frame is not read successfully, the reader 12 transmits a signal similar to the acknowledgement signal, but not within the second time window, to cause all the transponders not yet read to retransmit their preambles as hereinbefore described.

When a transponder is muted as hereinbefore described, the modulator 20 thereof is muted, but a random number generator (RNG) (not shown), but forming part of the controller 22 keeps running. Since the RNG is not reinitialized, it is believed that the degree of randomization is increased. The random number generator determines the random hold-off periods and random inter-transmission intervals.

It is believed that the method and protocol herein defined and described would reduce the time to read a transponder population, but that it would still be compatible with known protocols, such as the protocols referred to in the introduction of this specification. Furthermore, the protocol is expected to work with both so-called "transponder talks first" and "reader talks first" systems.

It will be appreciated that there are many variations in detail on the invention herein defined and described without departing from the scope and spirit of this disclosure.

5

Dated this 12 day of June 2000

Patent Attorney / Agent for the Applicant

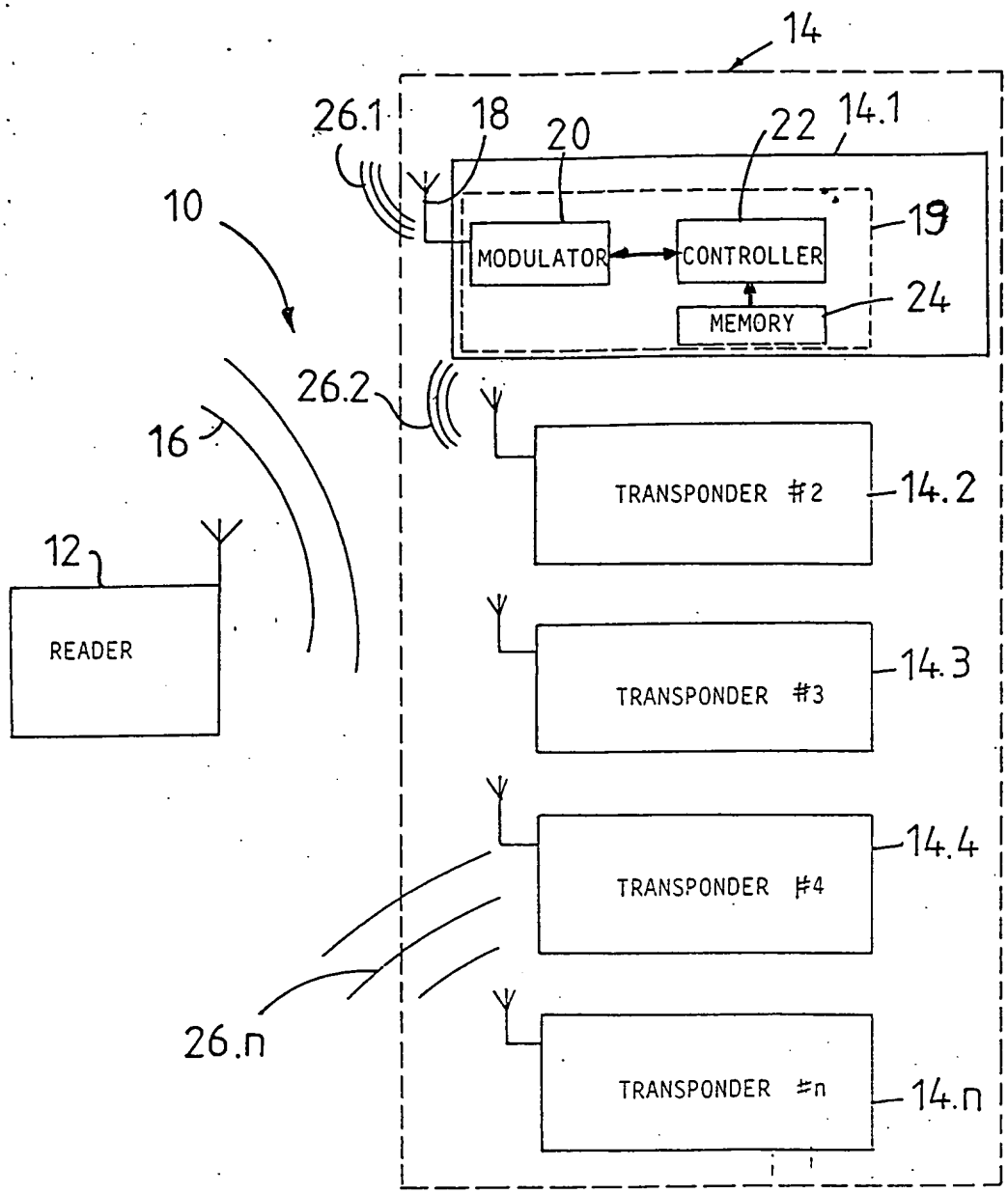

FIGURE 1

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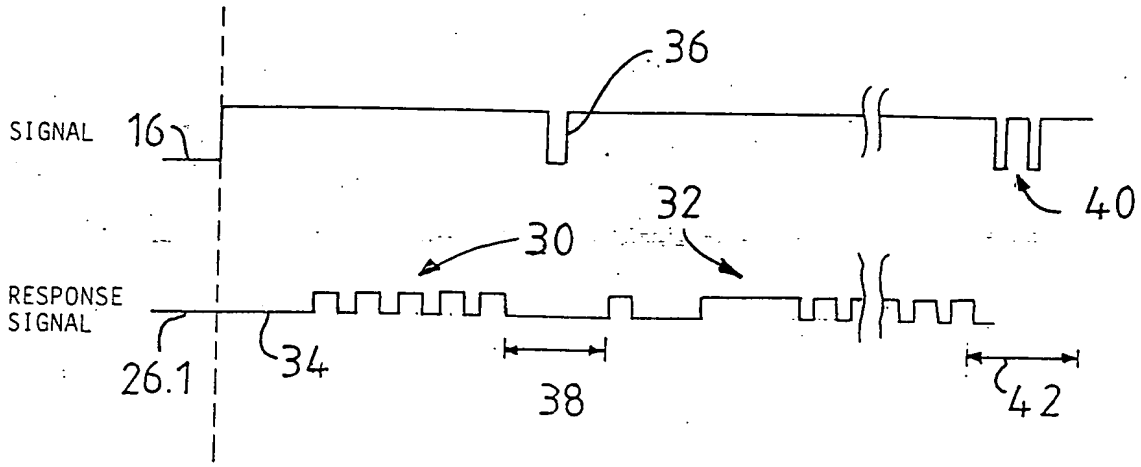

FIGURE 2

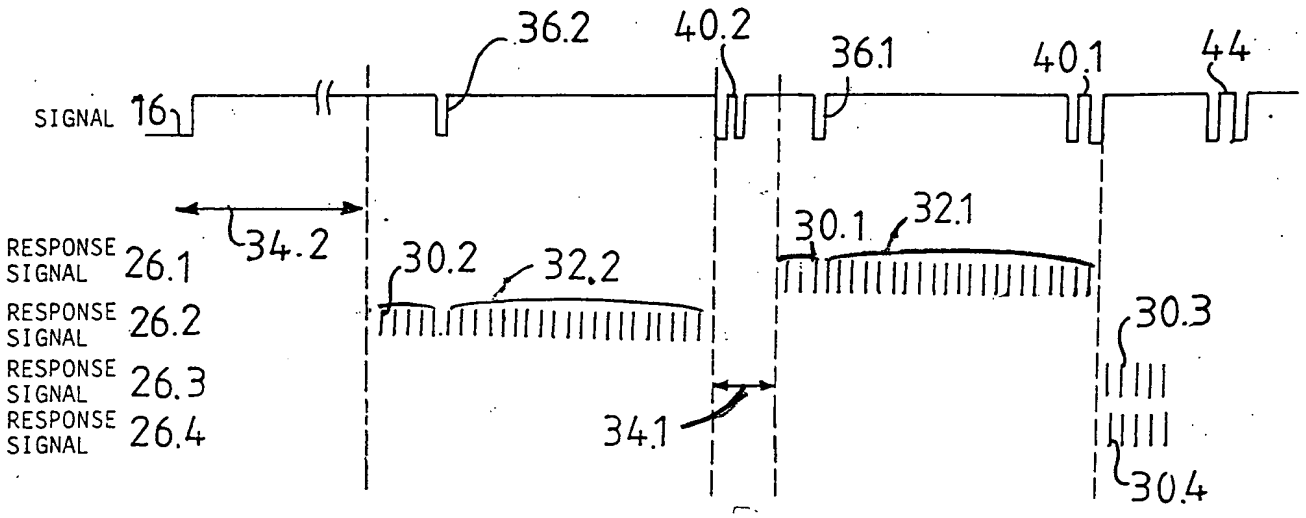

FIGURE 3

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